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ABSTRACT

The study focused on the Environmental Protection Agency's Black Creek Watershed project in Northeastern Indiana in relation to the farmers attitudes toward environmental innovations, as well as their continued use of such innovations 2.5 years after the project's completion. Data were gathered by 89 interviews at the beginning of the project (January 1974), supplemental interviews to determine adoption rate (February 1976), and final interviews with the 54 respondents left in the area (July 1980). Variables used in the interviews included: (1) farmer's education; (2) perceived need for innovation concerning soil conservation and water pollution; (3) farm size; (4) percent of off-farm employment; (5) leadership score; (6) Amish/non-Amish; (7) agency contacts; (8) advice sought from leaders, (9) orientation toward farming; (10) knowledge of project and persuasion toward it; and (11) use of environmental innovations. Although the research indicated a lack of knowledge concerning factors which explain conservation behavior, it suggested greater emphasis on identifying social, economic, and agronomic factors into a single model which could explain and predict the use of conservation practices. In addition, research indicated more contacts should be made with small farmers, and emphasized the need for formal communication links and education. (AH)

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Conservation Behavior: A Look at the Explanatory Power of the Traditional Adoption-Diffusion Model

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Water Quality! Erosion Control! Both continue to receive considerable support as goals of public policy. In recent years, we have greatly expanded our knowledge of the connections between erosion, soil productivity and water quality (Lake and Morrison, 1981). As a result of our increased understanding, we have created new innovations to control erosion and sedimentation (reduced tillage practices, PTO terraces, etc.). However, the research has also indicated that many of the practices recommended and subsidized by public policy and adopted by landowners in previous years are no longer being utilized. The GAO (1977) study suggests that the conservation agencies have not been overly successful in their attempts to encourage widespread use of conservation technologies. They especially are critical of the resources expended in encouraging the adoption of practices which are then discontinued. Their results suggest that the agencies need to be more oriented toward the goals of motivation of potential adopters as well as the adoption process. Recent hirings of behavioral scientists in the conservation agencies suggests increased desire to understand the adoption process, especially in terms of potentially mutable variables.

Adoption of Conservation Practices

The adoption of agricultural innovations has long been of interest to agricultural scientists from the early studies of hybrid seed corn to more recent investigations of conservation technologies. A model describing the innovation-decision process has been useful for many years. However, this model has generally been applied to the adoption of commercially profitable rather than environmental or preventive innovations. Pampel and Van Es (1977) have specifically questioned the applicability of the traditional model to the adoption of environmental land use practices. However, Taylor

and Miller (1978) point out several shortcomings in the Pampel and Van Es study and provide empirical evidence which supports the continued use of the traditional model with relatively minor modifications.

Recently, certain aspects of the Taylor and Miller (1978) study have also been criticized (Nowak and Korshing, 1979; Heffernan and Green, 1981). Taylor and Miller, themselves, note that limitations of their data prohibited them from examining the final stage of the innovation-decision process. Therefore, using Taylor and Miller's data, in addition to recently collected data, this paper will reexamine and extend the earlier study addressing these criticisms and limitations.

In the earlier study, Taylor and Miller (1978) attempted to determine the applicability of the adoption of environmental land use practices to Rogers and Shoemaker's (1971:102) traditional model of adoption. They used survey data collected from farmers in a northern Indiana watershed which was the site of a government sponsored water quality demonstration project. The project was designed to introduce a variety of erosion control agricultural structures and practices to the farmers in the watershed. Surveys were conducted with all landowners at the beginning of the project as well as at a later stage. This information allowed for the testing of a set of hypotheses derived from generalizations concerning the first three stages of the innovations-decision process found in Rogers and Shoemaker (1971).

They did, however, modify some of their hypotheses to reflect the findings of Pampel and Van Es (1977). Taylor and Miller (1978:637) state the following alteration of the Rogers and Shoemaker (1971) generalizations:

> "First, it is hypothesized that farmers whose general orientation is toward farming as a way of life will be more likely to adopt environmental innovations than farmers whose orientation is towards commercialism and profit. Second, it is hypothesized that farmers who adopt environmental innovations will tend to have lower socio-economic status, since they will be less

concerned with farming profits. Third, it is hypothesized that adopters will tend to be less cosmopolite than nonadopters, because they will be more likely to make their living totally from their land; since farming is their way of life, they will spend more time on the farm than off."

Taylor and Miller (1978) operationalized orientation towards farming as Amish/non-Amish. It was assumed that Amish farmers had a greater orientation towards farming as a way of life than the non-Amish. However, using a religious distinction to define this concept has been criticized (Nowak and Korshing, 1979; Heffernan and Green, 1981). Therefore, this study will not use Amish/non-Amish to distinguish one's orientation toward farming. Rather, we will operationalize this concent with an index that measures the magnitude to which farmers consider the importance of profitability in the operation of their farm. The Amish/non-Amish variable will remain in our analysis to distinguish those persons who belong to a traditional social system from those who belong to a more modern social system. The Amish are a group of people who have been identified as adhering to traditional norms and values (Kephart, 1972). According to the generalizations found in Rogers and Shoemaker (1971) members of a social system with traditional values will resist the use of new farm practices to a greater extent than those in a more modern social system.

Another important modification of the earlier study concerns the number of practices adopted by each farmer. Due to unavailable information Taylor and Miller (1978) were unable to determine exactly which practices were recommended for each respondent's land. Therefore, they were forced to define the farmers' "level of adoption" as the sum total of practices being utilized. Presently, we have information that allows us to determine the percentage of recommended practices currently in use by each respondent. This should provide a more accurate account of the farmers'

commitment to erosion control. The above has focused on the modification of the original study. We will now turn our attention to a discussion of the extension phase of our analysis.

While the literature indicates that adoption of these innovations is the focal point, the larger question is overall conservation behavior of American agriculturalists. Earlier research tended to measure conservation behavior by ascertaining the number of practices in use. However, this method has been subjected to substantial criticism because it does take into account where a specific practice is applicable to the particular farm in question (e.g., not having a grassed waterway is not an indication of anti-conservation behavior if no waterway exists on the farm). In response to these criticisms, researchers have begun to measure conservation behavior with a practice which is more universally applicable (e.g., conservation tillage). This measure does not, however, get at a very broad range of behavior and practices and some research suggests that on certain soil types, conservation tillage practices are a commercial innovation. The present study proposes that examining a wider range of conservation practices would provide a more accurate indicator of conservation behavior by the individual farmer. In order to construct such an indicator, it was necessary to obtain the recommended practices for each farm in the study area as well as which of them were currently being utilized. The recommended practices were obtained from each farms' conservation plan drawn up by the Soil Conservation Service, while current use was established in interviews with the respondents. This information provdes an assessment of the percentage of recommended practices that are actually in use by the farmer and assumes that a higher percentage of recommended practices in use is preferable and indicates greater conservation behavior.

The present research utilizes recently collected data which is an extension of the information used by Taylor and Miller (1978). The present data set was obtained two and a half years after completion of the demonstration project. This provides information with which to explore the explanatory power of the traditional adoption-diffusion model in the final stage of the adoption process.

The final stage of the process is called the confirmation stage. Rogers and Shoemaker (1971:113), state that:

> "Empirical evidence supplied by several researchers indicates that a decision to adopt or reject is not the terminal stage in the innovation-decision process. . . .At the confirmation function the individual seeks reinforcement for the innovation-decision he has made, but he may reverse his previous decisioin if exposed to conflicting messages about the innovation. The confirmation stage continues after the decision to adopt or reject for an indefinite period of time."

The confirmation stage may be particularly important in the case of environmental innovations, which do not contribute to the profitability of the farm firm. While financial aid was provided to help the farmers establish the recommended erosion control practices and structures, assistance was not provided for continued use. Because of non-profitability and lack of financial assistance, it may be that with the end of a demonstration project a number of farmers will discontinue their use of recommended practices. The present study will examine the continued use of selected environmental practices in terms of the traditional model of adoption-diffusion.

An examination of Rogers and Shoemaker (1971) reveals only two generalizations that directly pertain to the confirmation stage. Therefore, the present endeavor will be exploratory in nature since we are concerned with determining if the same factors that are associated with initial adoption are also related to continued use of environmental innovations. It should also be noted that this is not intended to be a rigorous examination of the

final stage of the innovation-decision process. We will primarily focus upon those farmers in the watershed who continued to use innovations two and a half years after completion of the demonstration project. However, to help guide our exploratory investigation we will use Rogers and Shoemaker's (1971:117) summary concerning continued and discontinued use of innovations.

> "Several investigations (Leuthold, 1967; Leuthold, 1965; Deutschmann and Haven, 1965; and Wilkening, 1952) have determined the characteristics of those individuals with a high and low rate of discontinuance. Generally, high discontinuers have less education, low social status, less change agent contact, and the like, which are the opposite of the characteristics of innovation. Discontinuers share the same characteristics as laggards, whom we know to have a higher rate of discontinuance".

A diagram of the innovation-decision process is depicted in Figure 1. This model indicates the importance of receiver and social system variables for knowledge of the innovation or program which should be highly correlated with persuasion toward the innovation. Persuasion is then suggested to be highly correlated with the decision to adjust the level of innovation. The emphasis is on how the antecedent variables act through the endogenous variables to influence adoption behavior. The present study will examine these relationships by analyzing the behavior of a group of agriculturalists within the above framework.

METHODOLOGY

Data

The data utilized in this study came from a multi-wave panel study of farmers located in the Black Creek Watershed in Northeastern Indiana. This area was the site of a major demonstration project designed to introduce pollution control practices to the local farmers. The "Black Creek Project" was funded by the Environmental Protection Agency and involved the

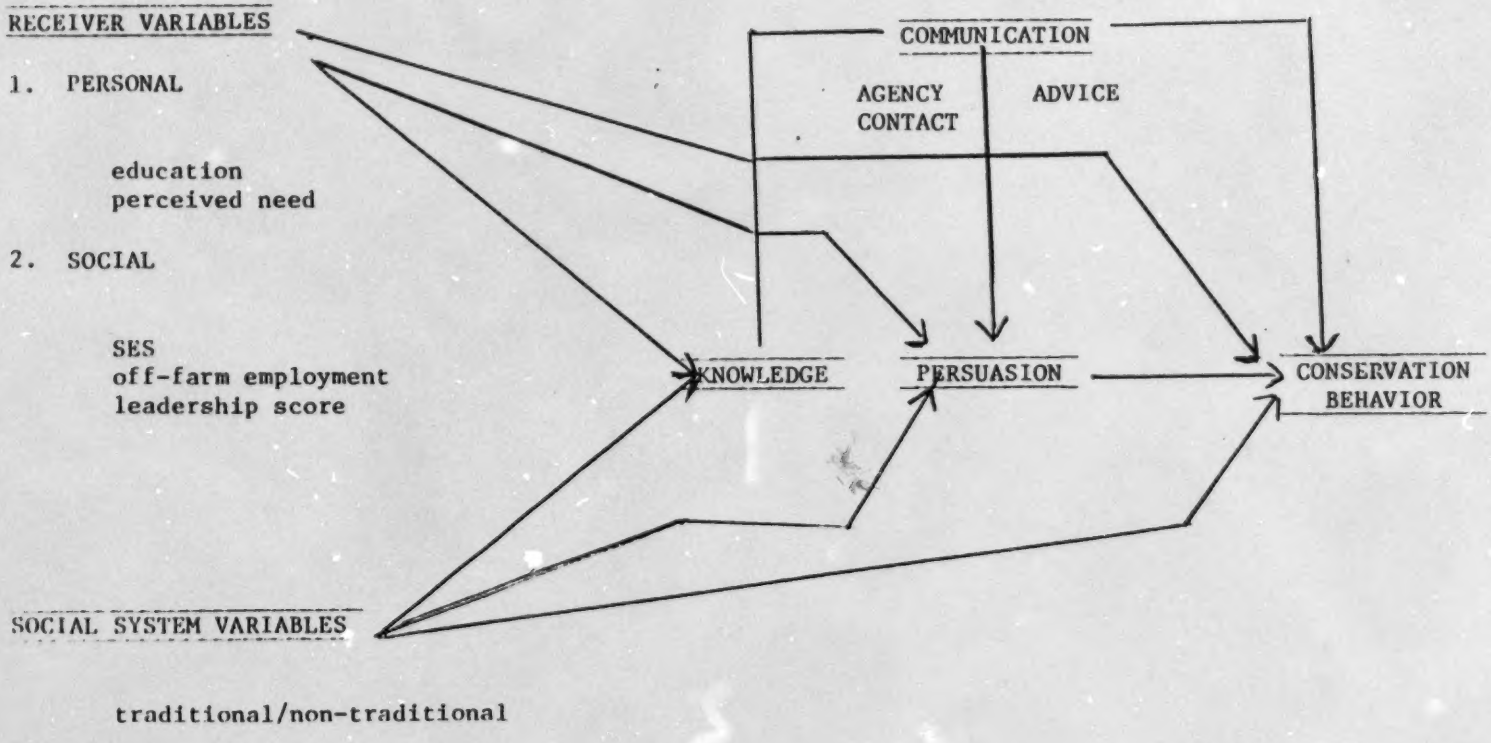

Figure 1. The Traditional Adoption-Diffusion Model [adopted from Taylor and Miller (1977)]

FIGURE 1

participation of several federal, state, andlocal government agencies as well as extensive client participation (Lake and Morrison, 1975). Information was collected from the respondents at three separate points in time through the use of personal interviews. The initial wave of interviews was conducted in January 1974, at the beginning of the project. In February 1976, a supplemental interview was conducted to determine the initial rate of adoption of conservation practices among the landowners. (See Taylor and Miller, 1976, for details of the study design for 1974 and 1976). The final wave of data was collected in July 1980, after completion of the demonstration project. (See Lovejoy and Parent, 1981 for details on the 1980 study.) Fifty-four of the original 89 respondents were revisited during this time period. The loss of respondents was primarily due to death, illness and outmigration and not an unwillingness of respondents to participate in the interviews.

Operationalization of the Variables

The operational scheme for each variable to be used in this analysis is presented below.

1. (EDUCATION74) Education of the farmer. This variable is the actual number of years of formal education the respondent had obtained in 1974.

2. (PN74) Perceived need for innovation. An index of two questions which ask the farmers their opinion concerning the problems of soil conservation and water pollution in their area in 1974. Range: 6 = large perceived need, 2 = no perceived need.

3. (ACRES74) Farm size. Operationalized as the total acres farmed by the respondent in 1974 and is utilized as a quasi-farm income

measure. A direct income measure was not utilized because of the inherent problems of reporting farm income (e.g., gross, net, before/after tax, return to capital/labor, etc.)

4. (% OFF-FARM74) Off-farm employment. Represents the reported percentage of the total income derived from non-farm activities in 1974.

5. (LEADER) Leadership score. The actual number of times an individual was mentioned by others as a well-respected agriculturalist in the area (1974).

6. (ETHGRP) Amish/non-Amish. Amish was coded as (1) and non-Amish as (2).

7. (AGENCY cont 74) Agency contact. The actual number of contacts a farmer reported having with project agencies in 1974.

8. (ADVICE74) Advice from leaders. Whether or not a farmer sought advice from a person he mentioned as a leader in 1974.

9. (PROFIT ORIEN) Orientation toward farming. To determine this variable each respondent was asked to rank a set of objectives in order of their importance in the way they operate their farm. The rank given these items that were considered to reflect an orientation towards profitability were then summed for eadch respondent. In this case a low score reflects a high degree of emphasis on income and profit.

10. (AGENCY cont 80) Agency contact. Number of times respondent was contacted by an agency about conservation practices or water quality.

11. (PN80) Perceived need 1980. Index of 2 questions which asks the farmers their opinion concerning the problems of soil conservation and water pollution in their area.

12. (ACRES 80) Acres farmed 1980. Total acres farmed in 1980.

13. (% OFF-FARM 80) Percent of income from off-farm sources 1980. Percent of total family income from non-farm sources.

14. (ADVICE80) Advice from leader. Whether or not a farmer sought advice from the person he nominated as a local leader in 1980.

15. (KNOW) Knowledge of the project. Determined by asking the respondents how ofamiliar they were with the Black Creek Demonstration Project in 1974.

16. (PERSUASION) Persuasion toward the project. An index of three questions designed to measure the farmers attitude toward the project in 1974.

17. (CONS. BEHAVIOR) USe of environmental innovations 1980. The percentage of recommended practices in use by each farmer in 1980. Recommended practices were obtained from the administrator of the Black Creek Demonstration Project. Of the ten innovations used in this analysis none had crop production as either a primary or secondary benefit (Lake and Morrison, 1977). The variables with their means and standard deviations are presented in Table 1.

Theoretically, the individual use of conservation practices should be predictable by information on the individuals knowledge and persuasion toward the project. These variables should be predictable by the antecedent receiver and social system variables. Figure 1 illustrates the pattern of the theoretical relationships between the variables. The theory indicates that the receiver and social system variables will affect conservation behavior but principally through the intervening variables of knowledge and persuasion. However, Table 3 (column 1) indicates that knowledge and persuasion account for only 5 percent of the variance in conservation behavior and none when adjusted for small sample size. When the additional

receiver and social system variables from 1974 are entered along with knowledge and persuasion (#2), the variables explain 3 percent of the variance, after adjustment for small sample size. Even when all the variables from 1974 to 1980 are utilized (#3), only 5 percent of the variance is explained. In design #4, knowledge and persuasion were utilized along with the 1980 variables but explanatory power was only 3 percent. However, the 1980 variables without knowledge and persuasion were able to account for 9 percent of the variance in conservation behavior. While it may seem somewhat discouraging to be able to explain less than 10 percent of the variance in conservation behavior, it must be remembered that several important factors have not been considered. Certainly the economic impact of using any technology is an important factor in determining whether an agriculturalist adopts it. Several studies (Miller, 1982) illustrate the costs associated with using many of these technologies. The costs are both initial investment cost as well as reductions in net revenue through decreased yields or quantity, increased input prices or different mix of land uses and crops. In addition, we have not accounted for the ability of these farmers to implement these practices on their farms, essentially, the management skills of the operator seem to have a significant role in the adoption and continued use of many of these conservation practices (especially the land use management practices).

On the bright side, it appears that some of the educational efforts in the Black Creek area were important in terms of conservation behavior. The individuals perception of the problem and perceived need for conservation practices in 1974 was negatively associated with conservation behavior, suggesting that those who indicated greater need for conservation in 1974 were using a smaller percentage of recommended practices than those who saw

less need. However, with the various educational activities and other sources of information, by 1980, the relationship between perceived need and conservation behavior was significantly positive, with a correlation coefficient of .30. In addition, amount of agency contact was still positively associated with conservation behavior. This illustrates the importance of formal communications in persuading farmers to use recommended land use practices. However, farm size is also positively associated with conservation behavior while few report that erosion problems are positively associated with farm size. To exacerbate this problem, the correlation coefficient between farm size in 1974 and agency contact in 1974 was .23 while in 1980 the coefficient was .44, suggesting that larger farmers were having more agency contact in 1974 than smaller farmers and that difference became greater by 1980 even though many of the most severe erosion and sedimentation problems were occuring on the smaller farms (Lake and Morrison, 1977).

SUMMARY

The results indicate that use of conservation practices seems to be a quite different phenomenon from that studied previously by social scientists. the variables that were quite important for explaining the use of commercial practices such as hybrid seed corn or liquid nitrogen do not exhibit strong explanatory power. The results do suggest the importance of formal communication links and education about the problem and need for solutions. However, the larger farms seem to be receiving greater attention than smaller farms and the difference in amount of agency contact have increased since 1974. While much of this may be the result of large landowners initiating contact with agencies. Since many of the more serious

problems have been identified on the smaller farms in Black Creek, it may be advantageous for the agencies (e.g., SCS, CES, ASCS) to initiate more contacts with the smaller farmers.

Overall, this research indicates the lack of knowledge concerning factors which explain conservation behavior. This suggests greater emphasis on identifying these factors as well as synthesizing several social, economic and agronomic factors into a single model which could explain and predict the use of conservation practices.

Table 1

		MEAN	STANDARD DEVIATION
X_1	EDUCATION 74	10.62	2.85
X_2	PN 74	3.95	1.56
X_3	ACRES 74	157.26	157.16
X_4	% OFF-FARM 74	35.98	34.06
X_5	LEADER	.64	1.66
X_6	ETH GROUP	1.71	.46
X_7	AGENCY CONT 74	8.40	3.10
X_8	ADVICE 74	.40	.50
X_9	PROFIT ORIEN	20.10	2.92
X_{10}	AGENCY CONT 80	39.95	73.10
X_{11}	PN 80	3.71	1.47
X_{12}	ACRES 80	245.38	313.23
X_{13}	% OFF-FARM 80	31.90	32.84
X_{14}	ADVICE 80	1.02	.75
X_{15}	KNOW	3.05	.82
X_{16}	PERSUASION	7.76	1.28
X_{17}	CONS. BEHAVIOR	60.98	33.63

Table 2

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}
X_1	-																
X_2	.35	-															
X_3	.00	-.09	-														
X_4	-.09	.06	-.45	-													
X_5	.00	.18	.39	-.32	-												
X_6	.36	.19	.18	.17	.25	-											
X_7	.38	.32	.23	-.08	.42	.44	-										
X_8	.40	.40	.12	-.08	.44	.52	.44	-									
X_9	-.32	-.02	-.15	.22	-.05	-.23	-.13	-.33	-								
X_{10}	.26	.35	-.05	-.16	.27	.19	.33	.39	-.23	-							
X_{11}	.45	.54	.16	-.12	.20	.24	.50	.40	-.29	.38	-						
X_{12}	.23	-.26	.41	-.26	.13	.30	.44	.04	-.33	.04	.35	-					
X_{13}	.06	.19	-.53	.56	-.22	-.06	-.15	-.08	.33	-.07	-.17	-.49	-				
X_{14}	.29	.00	-.06	.18	-.17	.45	.18	.04	-.15	-.09	-.02	.12	.17	-			
X_{15}	.34	.34	-.17	-.07	.15	-.03	.49	.14	.04	.15	.39	.07	.00	.04	-		
X_{16}	.47	.61	.07	-.12	.31	.34	.43	.35	-.06	.28	.52	-.03	.01	.21	.59	-	
X_{17}	-.02	-.06	.12	-.14	.14	.08	.30	-.08	.13	.22	.30	.24	-.05	-.01	.20	.18	

Table 3

Correlation Coefficient of Variable with Conservation Behavior Regression Design

VARIABLE	#1	#2	#3	#4	#5	#6
EDUCATION 74		-.02	-.02			
PN 74		-.06	-.06			
ACRES 74		.12	.12			
% OFF-FARM 74		-.13	-.13	-.13		
LEADER		N/S	.14			
ETH GROUP		.08	.08			
AGENCY CONT 74		.30	.30	.30		
ADVICE 74		-.08	-.08			
PROFIT ORIEN			.13		.13	.13
AGENCY CONT 80			.22	.22	.22	.22
PN 80			.30	.30	.30	.30
ACRES 80			.24	.24	.24	.24
% OFF-FARM 80			-.05		-.05	-.05
ADVICE 80			-.01		-.01	-.01
KNOW	.20	N/S	.20	.20	.20	
PERSUASION	.18	.13	.18	.18	.18	
R^2	.05	.22	.42	.15	.22	.22
Adjusted R^2	0	.03	.05	0	.03	.09

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